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Using longitudinal syndromic surveillance to describe small ruminant health in village production systems in Myanmar

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ABSTRACT

A novel syndromic surveillance approach was used to describe small ruminant health in Myanmar, to help overcome limitations in disease diagnosis common in many parts of the world, especially in low and middle income countries (LMICs). Observations were made from July 2015 to June 2016 of ten clinical syndromes in 12 goat herds and sheep flocks owned by smallholders in the Central Dry Zone. Strengths and weaknesses to using syndromic surveillance in a village setting were identified using a formal surveillance evaluation framework, 'SERVAL'. Larger reporting teams made disproportionately more reports than smaller ones (86% compared to 14% of all reports, with a reporting rate ratio of 4.3 95% CI 3.5–5.4), which may have affected surveillance sensitivity. The benefits of the syndromic surveillance included its relatively low cost and ability to produce quantitative disease estimates that could be used to prioritise further disease investigation and extension activities. In particular, significant mortality was observed, with monthly mortality of 3.0% (95% CI 2.5–3.7%) and 0.28% (0.15–0.53%) in young and adult animals, respectively, and a population attributable fraction of mortality for young animals of 82% (68–91%). Mortality was associated with ill-thrift in young animals but had not previously been considered an important production-limiting condition in Myanmar. This information contributes to an understanding of the prevalence of excessive mortality in smallholder goat and sheep production systems. It is a practical example of the use of syndromic surveillance in a LMIC livestock production system, the results of which can direct future disease research, treatment and prevention to improve the health and productivity of small ruminants in Myanmar.

1. Introduction

Goats and sheep (small ruminants, 'SRs') are vital to the livelihoods of many small-scale, poor rural households worldwide (Peacock, 2005; Wilson, 2009). However, in contrast to other ruminant livestock species, expertise in health and husbandry of SRs is often limited in low and middle income countries ('LMIC'; De Vries, 2008; Peacock and Sherman, 2010; Iñiguez, 2011). Although information on specific diseases may exist—particularly those that can be easily diagnosed with a serological test—information on the relative importance of sub-clinical and clinical health problems, and baseline data to prioritise more detailed health research are often limited. The capacity to investigate SR diseases in the field may be limited because of a lack of resources, infrastructure or adequately trained and experienced personnel (Nantima et al., 2014; Queenan et al., 2017), particularly because such systems often involve more animals and more fluctuating stock numbers than large ruminant systems.

Such challenges necessitate innovative, efficient approaches for collecting contextualised animal health information to help direct investments in more detailed disease investigations, treatment and control. Syndromic surveillance offers a different disease investigation paradigm that helps address these issues. It involves monitoring a broad range of clinical signs as indicators of the health status of animals, seeking to create a preliminary description and perspective of health problems without necessarily confirming diagnoses of specific diseases (Vial and Berezowski, 2015). It generally requires fewer resources and is cheaper than traditional surveillance systems (Sundufu et al., 2015) and, with appropriate training, can be used effectively by veterinary

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and non-veterinary personnel alike. It allows for timely data collection, helping to avoid recall bias. Used to collect 'baseline' information prospectively, syndromic surveillance data can efficiently direct further research and extension at the most severe, prevalent or production-limiting health problems (Akhtar and White, 2003).

Excessive mortality is one important example of a poorly described SR health and productivity issue. It can have major but underestimated effects on the productivity, profitability and sustainability of SR farming in many farming systems, although surprisingly few accurate estimates of SR mortality exist given the diversity of SR production worldwide (Sharma et al., 1981; Ikwuegbu et al., 1995; Hary et al., 2003; Nguti et al., 2003; Turkson, 2003; Campbell et al., 2014). Examples of the problem's scale include average lamb and kid mortality of 31% in traditional farming systems in Ghana (Turkson, 2003) and 44% of Australian wool-producing farms with post-weaning mortality exceeding industry recommendations (Campbell et al., 2014). Improving survival has been estimated to produce a net 5% benefit to enterprise gross margins in Australia (Campbell et al., 2008) and would be of more benefit in LMICs, where SR mortality is often higher. This demonstrates the need to accurately describe mortality in SR farming systems, and syndromic surveillance provides an excellent opportunity to do this in smallholder production systems.

We present a case study of applying syndromic surveillance to village-based SR production in the Central Dry Zone (CDZ) of Myanmar, which could be used in similar settings worldwide. We show its potential for describing animal health issues and quantifying mortality, and present practical measures of the system's performance in the LMIC setting. The CDZ is an area of approximately 54,000 km^2 located in the middle of Myanmar straddling the Ayeyarwaddy River. It is unique in South East Asia, being a semi-arid tropical environment with average annual rainfall of 600 mm and a short wet season from June to October (Haggblade and Boughton, 2013; Myanmar Information Management Unit, 2015). It is particularly affected by food security issues but is strategically located between two of the world's fastest growing markets for livestock products—India and China. More than 4 million SRs are in the CDZ, about 75% of the national population (Maclean, 2011). They are raised in traditional village production systems, typically utilising communal grazing lands. SRs in the CDZ are sold for meat and are an important source of household cash income. However, there is very little known about the current constraints to successful production, including the key health issues affecting SRs in village systems. In the present study, we employed a syndromic surveillance approach to describe SR health issues, to identify and to prioritise those warranting further investigation.

2. Materials and methods

The syndromic surveillance study was part of a larger field research project to describe existing production and health in village-based SR, cattle and poultry systems in the CDZ of Myanmar, and test interventions to overcome key productivity constraints (http://aciar.gov.au/project/ah/2011/054). Longitudinal syndromic surveillance was carried out from July 2015 to June 2016 in 12 SR herds and flocks from two villages in the CDZ of Myanmar. The field research was approved by the Postgraduate Research Review Committee of the University of Veterinary Science, Myanmar.

2.1. Research site selection and study population

Syndromic surveillance was carried out in two villages that were the key research sites for the larger project described above: Ya Thar (YT; 21.631°N 95.478°E) and Kyauk Aoe (KA; 20.801°N 95.586°E). The difficulties of travel approvals for expatriates in rural locations in Myanmar meant that these sites were selected using a combination of convenience sampling and quantitative data. The villages were in two 'townships' (local administrative areas generally comprising 100–400 villages) broadly representative of CDZ village livestock production systems and agroecology, according to previously published descriptions of the region (Henning et al., 2006; Maclean, 2011), local experts and the researchers' previous experience. From a short-list of potential, accessible research villages created during a scoping mission, the final sites were selected based on representativeness of livestock production, vehicle access, proximity to nearby towns and the availability of local veterinarians. A survey of 84% of villages in the two townships covering key village and livestock farming characteristics, including village size (number of households), proportion of landless households, proportion of households keeping different livestock species, and access to irrigation verified that both sites were within the interquartile range of all indicator variables. Key characteristics of the two research villages are described in Table 1.

Table 1
Key characteristics of research village sites used for syndromic surveillance (SR: small ruminant).

Village characteristic	Kyauk Aoe village	Ya Thar village
Households	130	500
Landless households	30	100
Households owning SRs	79	21
Households owning cattle	82	450
Median SR herd/flock size	46	48
Maximum SR herd/flock size	91	100
Minimum SR herd/flock size	24	21
SR breeds	Tai San (goats) Awassi (sheep)	Jai Ni (goats)

Within each village, six households farming SRs were selected, based on farmer interest, and ability to cooperate with animal identification and routine monitoring. In YT the only SRs raised were goats, whereas in KA both sheep and goats were raised, and two sheep flocks were deliberately included. All SRs in a household were monitored, with changes in the population due to births, mortalities, purchases and sales noted monthly.

2.2. Syndromic monitoring

Household herds/flocks were monitored monthly for clinical health abnormalities by project staff. Monitoring involved direct observation of animals, and discussions with the farmer and other project staff. Observations were grouped into ten non-mutually exclusive syndromic categories broadly aligned with body systems (Table 2; Pfeiffer et al., 2016). Throughout this paper, the term 'syndrome' is used to denote one of these syndromic categories. Project staff were trained in the syndromic monitoring before observations commenced and again during the study period. Observations were reported separately for

Table 2
Description of body system syndromic categories.

Syndromic category name	Description
mortality	death
lameness	sore or abnormal hoof, foot or leg causing abnormal movement
respiratory	breathing problems, coughing, sneezing
GIT	gastrointestinal; abnormal mouth, belly, faeces
neurological	changed behaviour, mental state, coordination; wobbling, circling
skin	changes to hair, fleece, or itching
reproduction	breeding or pregnancy problems, including abortion & stillbirth
urogenital	urine problems, including abnormal urine colour
ill-thrift	poor growth, generally unwell with no clear signs
other	other signs or problems that do not fit into any of the above categories